Conversational Agents, Humorous Act Construction, and Social Intelligence

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Abstract

Humans use humour to ease communication problems in human-human interaction and in a similar way humour can be used to solve communication problems that arise with human-computer interaction. We discuss the role of embodied conversational agents in human-computer interaction and we have observations on the generation of humorous acts and on the appropriateness of displaying them by embodied conversational agents in order to smoothen, when necessary, their interactions with a human partner. The humorous acts we consider are generated spontaneously. They are the product of an appraisal of the conversational situation and the possibility to generate a humorous act from the elements that make up this conversational situation, in particular the interaction history of the conversational partners.

1 Introduction

Embodied conversational agents have been introduced to play, among others, the role of conversational partner for the computer user. Rather than addressing the 'machine', the user addresses virtual agents that have particular capabilities and can be made responsible for certain tasks. The user may interact with embodied conversational agents to engage in an information service dialogue, a transaction dialogue, to solve a problem cooperatively, perform a task, or to engage in a virtual meeting. Multimodal emotion display and detection are among the research issues in this area of human-computer interaction. And so are investigations in the role of humour in human-computer interaction.

Humans use humour to ease communication problems in human-human interaction and in a similar way humour can be used to solve communication problems that arise with human-computer interaction. In Nijholt (2002) we discussed the role of humour for embodied conversational agents in the interface. It is a discussion on the possible role of humour support in the context of the design and implementation of embodied conversational agents. This paper is a revised version of Nijholt (2004). We discuss the role of embodied conversational agents in human-computer interaction and we have observations on the generation of humorous acts and on the appropriateness of displaying them by embodied conversational agents in order to smoothen, when necessary, their interactions with a human partner.

2 Humour in Interpersonal Interaction

In interpersonal interactions humans use humour, humans smile and humans laugh. Humour can be spontaneous, but it can also serve a social role and be used deliberately. A smile can be the effect of appreciating a humorous event, but it can also be used to regulate the conversation. Laughs have been shown to be related to topic shifts in a conversation (Consalvo, 1989).

2.1 Conversations and Dialogues

People smile and laugh when humour is used. It is not necessarily because someone pursues the goal of being funny or is telling a joke, but because the conversational partners recognize the possibility to make a funny remark fully deliberately, fully spontaneously, or something in between, taking into account social (display) rules, and then make this remark.

Humans employ a wide range of humour in conversations. Humour support, or the reaction to humour is an important aspect of personal

interaction and the given support shows the understanding and appreciation of humour. In Hay (2001) it is pointed out that there are many different support strategies. Which strategy can be used in a certain situation is mainly determined by the context of the humorous event. Humour support may show our involvement in a discussion, our motivation to continue and how much we enjoy the conversation or interaction.

Sometimes, conversations have no particular aim, except the aim of providing enjoyment to the participants. The aim of the conversation is to have an enjoyable conversation and humour acts as a social facilitator. In Tannen (1984), for example, an analysis is given of the humorous occurrences in the conversations held at a Thanksgiving dinner. Different styles of humour for each of the dinner guests could be distinguished. All guests had humorous contributions. For some participants more than ten percent of their turns were ironic or humorous. Humour makes one's presence felt, was one of her conclusions.

Similarity in humour appreciation also supports interpersonal attraction (Cann *et al.*, 1997). This observation is of interest when later we discuss the use of embodied conversational agents in user interfaces. Sense of humour is generally considered a highly valued characteristic of self and others. Nearly everybody claims to have an average to above average sense of humour. Perceived similarity in humour appreciation can therefore be an important dimension when designing for interpersonal attraction.

Other studies show how similarity in attitudes is related to the development of a friendship relationship. The development of a friendship relationship requires time, but especially in the initiation phase similarities are exploited (Stronks *et al.*, 2001).

2.2 Benefits

As mentioned, humour helps to regulate a conversation and can help to establish some common ground between conversational partners. It makes a conversation enjoyable and it supports interpersonal attraction.

Many benefits have been mentioned regarding humour in the teaching or learning process and sometimes they have been made explicit in experiments. Humour contributes to motivation attention, promotion of comprehension and retention of information, a more pleasurable learning experience, a development of affective feelings toward content, fostering of creative thinking, reducing anxiety, etc. The role of humour during instruction has been discussed in several papers. Despite the many experiments, it seems to be hard to generalize from the experiments that are conducted (Ziv,1988).

Describing and explaining humour in small task-oriented meetings is the topic of a study conducted by Consalvo (1989). An interesting and unforeseen finding was the patterned occurrence of laughter associated with the different phases of the meeting. Others have reported similar findings for different phases in negotiations or problem solving.

3 Embodied Conversational agents

Embodied conversational agents (ECAs) have become a well-established research area. Embodied agents are agents that are visible in the interface as animated cartoon characters or animated objects resembling human beings. Experiments have shown that ECAs can increase the motivation of a student or a user interacting with the system.

Embodied agents are meant to act as conversational partners for computer users. An obvious question is whether they, despite available verbal and nonverbal communication capabilities, will be accepted as conversational partners. That is, can we replace one of the humans in a human-to-human interaction by an embodied conversational agent without being able to observe important changes in the interaction behaviour of the remaining human? Can we model human communication characteristics in an embodied conversational agent that guarantee or improve natural interaction between artificial agent and human partner? Obviously, whether something is an improvement or more natural depends very much on the context of the interaction, but being able to model such characteristics allows a designer of an interface containing embodied agents to make decisions about desired interactions.

In the research on the 'computers are social actors' (CASA) paradigm (Reeves & Nass 1996) it has been convincingly demonstrated that people interact with computers as they were social actors. Due to the way we can let a computer interact, people may find the computer polite, dominant, extrovert, introvert, or whatever attitudes or personality (traits) we can display in a computer. Moreover, they react to these attitudes and traits as if a human being displayed them.

From the many CASA experiments we may extrapolate that humour, because of its role in human-human interaction, can play an important role in human-computer interactions. This has been confirmed with some specially designed experiments (Morkes et al. 2000) to examine the effects of humour in task-oriented computer-

mediated communication and in human-computer interaction.

4 Generation and Appropriateness

4.1 Introduction

In the previous sections we discussed the role of humour in human-human interaction and a possible role of humour in human-ECA interaction. Obviously, there are many types of humour and it is certainly not the case that every type of humour is suited for any occasion during any type of interaction. Telling a joke among friends may lead to amusement, while the same joke among strangers will yield misunderstanding or be considered as abuse. Therefore, an assessment of the appropriateness of the situation for telling a joke or making a humorous remark is necessary in all situations.

Appropriateness does not mean that every conversational participant has to be in a jokey mood for a humorous remark. Rather, it means that the remark or joke can play a role in the interaction process, whether it is deliberately aimed at achieving this goal, whether there is a mutually accepted moment for relaxing and playing or whether it is somewhere in between on this continuum. Clearly, it is also the 'quality' of the humorous remark that makes it appropriate in a particular situation. Here, 'quality' does not only refer to the contents of the remark, which may be based on a clever observation or ingenious wordplay, but in particular on an assessment whether or not to produce the humorous utterance. Just to make things more complicated, in some situations the possibility and the urge to make a humorous remark may overrule almost any social rule on how to behave.

In what follows we will talk about Humorous Acts (HA's). In telephone conversations a HA is a speech utterance. Apart form the content of what is being said, the speaker can only use intonation and timing in order to generate or support the humorous act.

In face-to-face conversations a humorous act can include, be supported or even made possible, by non-verbal cues. Moreover, references can be made, implicitly or explicitly, to the environment that is perceivable for the partners in the conversation. This situation also occurs when conversational partners know where each of them is looking at.

We emphasize again that participants in a discussion may, more or less deliberately, use humour as a tool to reach certain goals. A goal may be to smooth the interaction and improve mutual understanding. In that case a HA can generate and can be aimed at generating feelings of common attitudes and empathy, creating a bond between speaker and hearer. Whatever the aim is, conversational participants need to be able to compose elements of the context in order to generate a HA and they need to assess the current context (including their aims) in order to determine the appropriateness of generating a HA. This includes a situation where the assumed quality of the HA overrules conventions concerning cooperation during a goal-oriented dialogue.

We emphasize the spontaneous character of HA construction during conversational humour. The opportunity is there and although the generation is intended, it is also unpredictable and irreproducible. Nevertheless, it can be aimed at entertaining, to show skill in HA construction or to obtain a cooperative atmosphere. HA creation can occur when the opportunity to create a HA and a humorous urge to display the result temporarily overrules Gricean interaction principles concerning truth of the contribution, completeness of the contribution, or relevance of the contribution for the current conversation.

Generation (and interpretation) of HA's during a dialogue or conversation has hardly been studied. There is not really a definition, but the notion of conversational humour has been introduced in the literature (Attardo 1996).

4.2 Staging ECA Humour Generation

In Human-Computer Interaction one of the partners has to be designed and implemented. While on the one hand we need to understand as good as possible the models underlying human communication behaviour, this also gives us the freedom to make our own decisions concerning communication behaviour of the ECA, taking into account the particular role it is expected to play. From a design point of view, everything is allowed to make an ECA believable. In ECA design, rather than adhere to a guideline that says "try to be as realistic as possible", the more important guideline is "try to create an agent that permits the audience's suspension of disbelief."

When looking at embodied conversational agents we need to distinguish four modes of humour interpretation and generation. We mention these modes, but it should be understood that we are far from being able to provide the necessary appropriate models that allow them to display these skills. On the other hand, we don't always need agents that are perfect, as long as they are believable in their application. The first two modes concern the skills of the ECA:

- The ECA should be able to generate HA's. How should it construct and display the HA? When is it appropriate to do so? Apart from the verbal utterance to be used, it should consider intonation, body posture, facial expression and gaze, all in accordance with the HA. The ECA should have a notion of the effect and the quality of the HA in order to have it accompanied with nonverbal cues. Moreover, when in a subsequent utterance its human partner makes a reference to the HA, it should be able to interpret this reference in order to continue the conversation.
- The ECA should be able to recognize and understand the HA's generated by its human conversational partner. Apart from understanding from a linguistic or artificial intelligence point of view, this also requires showing recognition (e.g., for acknowledgement) and comprehension by generating appropriate feedback, including nonverbal behaviour (facial expression, gaze, gestures and body posture).

These are the two ECA points of view. Symmetrically, we have two modes concerning the skills of the human conversational partner. Generally, we may assume that humans have at least the skills mentioned above for ECAs.

- The human conversational partner should be able to generate HA's and accompanying signals for the ECA. Obviously, the human partner may adapt to the skills and personality of the particular ECA, as will be done when having a conversation with an other human.
- The human conversational partner should recognize, acknowledge and understand HA generation by the ECA, including accompanying nonverbal signals. Obviously, the ECA may have different ideas about acts being humorous than its particular conversational partner.

Our aim is to make ECA's more social by investigating the possibility to have them generate humorous acts. Two observations are in order. Firstly, when we talk about the generation of a HA and corresponding nonverbal communication behaviour of an ECA we should take into account an assessment of the appropriateness of generating this particular HA. This includes an assessment of the appreciation of the HA by the human conversational partner and therefore it includes some modelling of the interpretation of HA's by human conversational partners. That is, a model for generation of HA's requires a model of interpretation and appreciation of HA's. This is not really different from discourse modelling in general. An ECA needs to make predictions of what is going to happen next. Predictions help to interpret a next dialogue act or, more generally, a successor of a humorous act.

A second observation also deals with what is happening after introducing a HA in a conversation. What is its impact on the conversation and the next dialogue acts from a humour point of view? This introduces the issue of humour support, that is, apart from acknowledging, will the conversational partner support and further contribute to the humorous communication mood.

Finally, as a third observation, we need to consider whether HA generation by a computer or by an ECA gives rise to HA's that are essentially different and maybe more easily generated or accepted than human-generated HA's. An ECA may have less background and be less erudite, but it may have encyclopaedic knowledge of computers or a particular application. In addition, a computer or an ECA can become easily the focus of humour of a human conversational partner. Being attacked because of imperfect behaviour can be anticipated and the use of self-deprecating humour can be elaborated in the design of an ECA.

4.3 Appropriateness of HA Generation

Humour is about breaking rules, e.g. violating politeness conventions or, more generally, violating Gricean rules of cooperation. In creating humorous utterances during an interaction people hint, presuppose, understate, overstate, use irony, tautology, ambiguity, etc. (Brown and Levinson, 1978), i.e., all kinds of matters that do not follow Grice's Maxims. Nevertheless, humorous utterances can be constructive, that is, support the dialogue, and there can be a mutual understanding and cooperation during the construction of a HA. The HA's we would like to consider are, contrary to canned jokes that often lack contextual ties, woven into the discourse.

For HA construction, we need to zoom in on two aspects of constructing humorous remarks:

- recognition of the appropriateness of generating a humorous utterance by having an appraisal of the events that took place in the context of the interaction; dialogue history, goals of the dialogue partners (including the dialogue system), the task domain and particular characteristics of the dialogue partners have to be taken into account; and
- using contextual information, in particular words, concepts and phrases from the dialogue and domain knowledge that is available in networks and databases, to generate an

appropriate humorous utterance, i.e., a remark that fits in the context and that nevertheless is considered to be funny, is able to evoke a smile or a laugh, or that maybe is a starting point to construct a funny sequence of remarks in the dialogue.

It is certainly not the case that we can look at both aspects independently. With some exceptions, we may assume that, as should be clear from human-human interaction, HA's can play a useful and entertaining role at almost every moment during a dialogue or conversation. Obviously, some common ground, some sharing of goals or experiences during the first part of the interaction is useful, but it is also the quality of the generated HA that determines whether the situation is appropriate to generate this act. We cannot simply assess the situation and decide that now is the time for a humorous act. When we talk about the possibility to generate a HA and assume a positive evaluation of the quality of the HA given the context and the state of the dialogue context, then we are also talking about appropriateness.

4.4 Generation of HA's: An Example

Below we present an example of constructing a humorous act using linguistic and domain knowledge. The example is meant to be representative for our approach, not for its particular characteristics. It is an example of deliberately misunderstanding, an act that can often be employed in a conversation when some ambiguity in words, phrases or events is present, in order to generate a HA. Consider the text used in a Dilbert cartoon where a new "Strategic Diversification Fund" is explained in a dialogue between the Adviser and Dilbert:

Adviser: "Our lawyers put your money in little bags, then we have trained dogs bury them around town."

How to continue from this utterance? Obviously, we are dealing with a situation that is meant to create a joke, but nevertheless, all the elements of a non-constructed situation are there. What are these dogs doing? Burying lawyers or bags? So, a continuation could be:

Dilbert: "Do they bury the bags or the lawyers?"

Surely, this Dilbert remark is funny enough, although, from a natural language processing point of view it can be considered as a clarifying question, without any attempt to be funny. There is an ambiguity, that is, the system needs to recognize that generally dogs don't bury lawyers and therefore 'them' is more likely to refer to bags than to lawyers. Dogs can bury bags, dogs don't bury lawyers.

We need to be able to design an algorithm that is able to generate this question at this particular moment in the dialogue. However, the system should nevertheless know that certain solutions to this question are not funny at all. It can take the most likely solution, from a common sense point of view, but certainly this is not enough for our purposes. We need to introduce algorithms for anaphora resolution that decide to take a wrong but humorous solution, rather than that they take solutions that are the most likely correct ones. Obviously, then there is the question when this incorrect solution leads to a funny remark. When looking at previous language and humour research we can start with results that tell us about word and word meaning relations.

The example is certainly not complete in illustrating the full range of research aspects we need to tackle. In the cartoon we have a linguistic ambiguity, it can be resolved using common-sense knowledge and advanced methods for reference resolution, and we choose not to resolve it that way because we recognize that a less obvious solution can be used to construct a humorous continuation of the dialogue. In order to recognize this less obvious solution we need to include it on a stack of solutions, where in general the order of elements on

Figure 1: Strategic diversification Fund

the stack is determined by the increasing possibility to relate it to features of the antecedent in the history of the dialogue and the real world (Lappin and Leass, 1994). However, in this case, rather than following the order of the stack from the top to the bottom, we need to make a shortcut from elements, probably near the bottom of the stack, to nodes in a network containing semantic information that allows to reason about possibly humorous relationships between words and concepts.

4.5 Discussion

Although we have not seen humour research devoted to erroneous anaphora resolution, the approaches in computational humour research in general are not that different from what we saw in the example presented here. The approaches are part of the incongruity-resolution theory of humour. This theory assumes situations – either deliberately created or spontaneously observed – where there is a conflict between what is expected and what actually occurs. Ambiguity plays a crucial role. Phonological ambiguity, for example in certain riddles, syntactic ambiguity, semantic ambiguity of words, or events that can be given different interpretations by observers. Due to the different interpretations that are possible, resolution of the ambiguity may be unexpected, especially when one is led to assume a 'regular' context and only at the last moment it turns out that an other context allowing an other interpretation was present as well. These surprise disambiguations are not necessarily humorous. Developing criteria to generate humorous surprise disambiguations only is one of the challenges of humour theory. Attempts have been made, but they are rather preliminary. Pun generation is one example (Binsted & Ritchie, 1997), acronym generation (Stock & Strapparava, 2003) an other. In both cases we have controlled circumstances. These circumstances allow the use of WordNet and WordNet extensions and reasoning over these networks, for example, to obtain a meaning that does not fit the context or is in semantic opposition of what is expected in the context. No well-developed theory is available, but we see a slow increase in the development of tools and resources that make it possible to experiment with reasoning about words and meanings in semantic networks, with syllable and word substitutions that maintain properties of sound, rhyme or rhythm and with some higher-level knowledge concepts that allow higher-level ambiguities.

5 Tools, corpora, future research

5.1 Introduction

When discussing humour research for ECAs and their future development it is useful to distinguish between methods, tools and resources for verbal HA generation and methods and tools that may be called to help in order to have ECA's generate and display HA's using non-verbal communication acts. Graphics, animation and speech synthesis technology make it possible to have ECAs that display smiles, laughs and other signs of appreciation of the interaction. Multimodal and affective mark-up languages need to be extended in order to include the multimodal presentation of humorous acts in ECA behaviour.

5.2 Corpora, Annotations, Markup

Corpora are needed in order to study the creation of HA's in dialogues and naturally occurring conversations, including conversations that make references to common knowledge, task and domain knowledge, conversation history and the two- or three-dimensional visualized context of the conversation. With visualized context we mean the ECA and its environment (e.g., a reception desk, a lounge, posters in the environments, a particular training environment, other ECAs, including users and visitors, et cetera).

Corpora of conversations have been collected, but until now this collecting has hardly or not all been done from the point of view of humour or emotion research.[1] Consequently, hardly any experiments can be reported that have been performed using a corpus containing data that can be explored from the point of view of humour research. Hence, there is no attention to analysis, annotation, training, recognition or generation from a humour research and humour application point of view.

During a conversation or dialogue, having a particular HA or joke schema, an ECA can detect the appropriate moment to generate a particular type of joke or HA and it can use the average three-dimensional head movements to display the joke using verbal and nonverbal humour features.

[1] There exist corpora of jokes and, more interestingly for our purposes, there are corpora of conversations and dialogues between humans and computer services (e.g., travel and flight information). It will be interesting to look at corpora that are being collected and studied in the context of the European FP6 Integrated Project AMI (Augmented Multi-party Interaction) on meetings and the European FP6 Network of Excellence HUMAINE (Human-Machine Interaction Network on Emotion).

Average nonverbal communication behaviour as described in the previous paragraphs can be adapted by adding personality and emotional characteristics features. See (Ball and Breese, 2000), linking emotions and personality to nonverbal behaviour using Bayesian Networks. In (Allbeck and Badler, 2002), the emphasis is on adapting the gestures of ECA to its personality and gestures features.

5.3 Future Research Approaches

In the line of research on autonomous (intelligent and emotional) agents we need an ECA to understand why the events that take place generate enjoyment by its conversational partner and why it should display enjoyment because of its partner's appreciation of a HA. That is, models are needed that allow generation, prediction, detection and interpretation of humorous events. What events need to be distinguished, how does the ECA perceive them, and how does it integrate them at a semantic and pragmatic level of understanding of what is going on? There are two approaches to this question when we look at state-of-the-art research. One approach deals with speech and dialogue act prediction. What is going to happen next, given the history and the context of the dialogue? Can an ECA predict the next dialogue act by its conversational partner or can it compute the next dialogue act that is expected by its (i.e., the ECA's) conversational partner? Previous and possibly future dialogue acts are events that need to be 'appraised'.

In earlier research we used Bayesian Networks in order to predict dialogue acts. While this approach is unconvential from the usual point of view of event appraisal, it is an accepted approach in dialogue modelling research that has been implemented in a number of dialogue systems. Some attempts have been made to introduce multimodal dialogue acts. It seems to be useful to introduce more refined dialogue acts that take into account the willingness of a conversational partner to construct a humorous utterance and that take into account the possibility to give interpretations to (parts of) previous utterances that may lead to humorous acts. Obviously, in order to be able to do so we need corpora of natural conversations that allows us to design, train and test algorithms and strategies. Holistic user-state modelling, as advocated in the German SmartKom project (http://www.smartkom.org/), is a possible way to obtain data from which recognition algorithms can be designed.

Clearly, with such an approach we enter the area of emotion research. One of its viewpoints is that of appraisal theory, the evaluation of events and situations followed by categorizing arising affective states. Some of the theories that emerged from this viewpoint have been designed with computation in mind: designing a computational model to elicit and display emotions in a particular situation. A mature theory for calculating cognitive aspects of emotions is the OCC model, a framework of 22 distinct emotion types. A revised version of this model, presented in the context of believable ECA design was given in Ortony (2001). Can we make a step from event appraisal theories for deciding an appropriate emotion to appraisal theories for deciding the appropriateness of constructing a humorous act? As mentioned, issues that should be taken into account are the ability to construct a HA using elements of the discourse and the appropriateness of generating a HA in the particular context. In human-computer interaction applications some (mostly, stripped-down) versions of the model have been used.

It seems also useful to review existing theories and observations concerning the appraisal of (humorous) situations (available as events, in conversations, in verbal descriptions or stories) in terms of possible agent models that include explicit modules for beliefs, desires, intentions and emotions. Believes, desires and intentions (goals) define the cognitive state of an agent. Because of perceptive events state changes take place. From the humour modelling point of view agent models of states and state changes need to include reasoning mechanisms about situations where there is the feeling that on the one hand the situation is normal, while at the same time there is a violation of a certain commitment of the agent about how things ought to be. From a humour point of view, relevant cognitive states should allow detection of surprise, incongruity and reconstruction of incongruity using reasoning mechanisms.

6 Conclusions

This paper touches upon the state of the art of conversational agents, humour modelling and affective computing. We made clear that it is useful to introduce characteristics of human-human interaction in agent-human interaction, including the generation of humour and the display of appreciation of humour. We introduced the notion of a humorous act in a conversation. No algorithms for constructing humorous acts or for deciding when to generate an act were given. Rather we discussed the issues involved and we presented examples.

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